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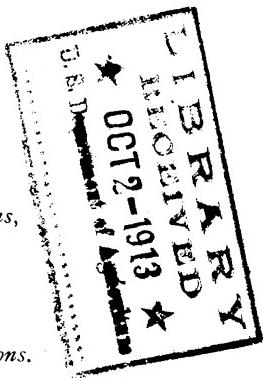
POP CORN FOR THE MARKET.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., May 6, 1913.

SIR: I have the honor to transmit herewith a manuscript entitled "Pop Corn for the Market," by Mr. C. P. Hartley, Physiologist in Charge of Corn Investigations, and Mr. J. G. Willier, Scientific Assistant, Office of Corn Investigations, and recommend that it be published as a Farmers' Bulletin.

Respectfully,

Wm. A. TAYLOR,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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POP CORN FOR THE MARKET.¹

DESCRIPTION OF POP CORN.

The principal characteristic that serves to distinguish pop corn from other kinds of corn is the tendency of its kernels to evert or turn inside out on being heated. This peculiarity has given rise to the scientific name of *Zea everta*, by which term pop corn is known to the botanist. It differs from the flint type of corn in having a larger proportion of corneous endosperm or horny substance constituting the starchy portion of the kernel. The ears and kernels are smaller than those of field corn and the stalks more slender and more inclined to exhibit a purple color. Most varieties ordinarily bear more than one ear to the stalk. There does not appear to be any record of the origin or early history of pop corn, but evidences seem to indicate that it was grown by the Indians.

VARIETIES OF POP CORN.

TYPES AND CLASSES.

There are two well-defined types of pop corn—the rice type, with sharp-beaked kernels, and the pearl type, with smooth or rounded kernels. Each of these two types may be subdivided into a number of different classes or varieties, according to color and according to size and time required to mature. The subdivision of these two types according to these characters has given some 25 or more varieties of pop corn.²

There is no demand for the colored varieties. Some of these have excellent popping quality and good flavor, but as the popped kernels do not completely hide the colored hull they do not make as attractive an appearance as the white varieties. The less coloring matter there is in the hull or seed coat the prettier will be the snowy white mass of popped kernels.

Of the pearl type the principal varieties are the Common White Pearl, Queen Golden, and Eight-Rowed. All of these are grown to a limited extent as compared to White Rice. The Silver Lace and Mapledale varieties are selections of White Pearl. Because of the large size of its popped kernels the Eight-Rowed variety is in demand at Christmas time for decorative purposes.

¹ For information regarding home uses of pop corn, see Farmers' Bulletin 553, entitled "Pop Corn for the Home."

² In Bulletin 57, Office of Experiment Stations, United States Department of Agriculture, Sturtevant describes 25 varieties of pop corn.

Descriptions are also given by Halsted in the Report of the Botanist, New Jersey Agricultural College Experiment Station, 1905.

THE LEADING VARIETY.

The White Rice is grown most extensively and is preferred on the large markets and by pop-corn venders. This variety is usually listed by dealers under the common name of White Rice. Some seedsmen have selected strains which they offer under special names, as Improved White Rice, Snowball, Early White Rice, Monarch White Rice, Old Homestead, etc.

EXTENT OF PRODUCTION.

Pop corn is grown in practically all of the States. The main portion of the market supply, however, comes from a few States in the section known as the corn belt. Table I, compiled from census figures, shows the production and value of the crop for the leading pop-corn-producing States in 1909.

TABLE I.—*Production of pop corn in 1909, by States.*

State.	Farms reporting.	Acres grown.	Bushels produced.	Value.
Iowa.....	428	5,345	197,322	\$135,270
Nebraska.....	213	2,167	51,130	33,854
Illinois.....	189	998	.....	28,994
Kansas.....	193	520	9,191	9,245
Ohio.....	172	439	.....	16,878
Michigan.....	200	362	.....	12,443
California.....	59	361	.....	10,184
Indiana.....	109	357	12,466	12,337
New York.....	188	344	.....	13,697
Minnesota.....	73	266	5,419	5,340
Wisconsin.....	54	184	8,762	7,044

Table II gives the production by counties for the year 1909. Only the leading pop-corn-producing counties are shown.

TABLE II.—*Pop-corn production, by leading counties, in 1909.*

State and county.	Farms reporting.	Acres grown.	Bushels produced.	Value.
Iowa:				
Sac.....	192	3,098	117,505	\$79,415
Ida.....	74	1,535	58,490	36,390
Nebraska:				
Valley.....	74	1,303	31,698	18,032
Greeley.....	19	309	6,260	4,056
Knox.....	8	97	2,260	1,634
Illinois:				
Carroll.....	3	128	.....	2,660
Gallatin.....	6	121	.....	1,680
Lasalle.....	4	97	.....	3,383
Kansas:				
Shawnee.....	4	48	1,590	1,120
Bourbon.....	3	32	1,266	1,071
Ohio:				
Montgomery.....	20	70	.....	1,752
Lorain.....	8	36	.....	1,500
Michigan:				
Monroe.....	15	46	.....	2,816
California:				
Los Angeles.....	40	310	.....	8,887
Indiana:				
Laporte.....	4	48	1,354	1,090
Dearborn.....	3	47	2,966	1,782
New York:				
Wayne.....	7	25	.....	1,498
Minnesota:				
Lyon.....	5	90	1,470	1,270
Wisconsin:				
Racine.....	10	53	2,273	1,404
Kenosha.....	7	44	2,510	1,795

In Iowa the principal centers of production were at Odebolt, Arthur, Idagrove, Battle Creek, Schaller, and Wall Lake, and in Nebraska at Arcadia, Bloomfield, North Loup, Ord, and Scotia. Pop corn was also grown commercially at Mapleton, Oakland, and Topeka, in Kansas; Burlington and Waterloo, in Wisconsin; Chadwick, Eureka, Gilman, and Paris, in Illinois; Harrison, Ohio; and at various other points in these and other States.

POPPING QUALITY.

THEORY OF POPPING.

The exact nature of popping is not well understood. Formerly it was supposed to be caused by the expansion of oil in the kernel on being heated, but at the present time it is believed to be due to the expansion of the moisture contained in the starch cells. The general belief now is that on the application of heat, as from a good bed of coals, this moisture expands with sufficient force to cause an explosion of the cells and the kernel turns completely inside out, enveloping the embryo and hull. It is probable that the expansion of the air within the seed coat also has something to do with the popping. The seed coat should be sufficiently dry and hard to afford much resistance to expansion.

FACTORS INFLUENCING THE POPPING QUALITY.

Hereditary influences.—Careful tests have shown that the pollination of white pop corn with pollen from yellow field corn affects the flavor, texture, and color of the popped kernels that were cross-pollinated. In other words, the planting of good, pure pop corn within 10 or 20 rods of field corn is likely to ruin both kinds for seed and injure the popping quality of the pop corn.

Physical conditions.—To give satisfactory results in popping, corn should ripen fully on the standing stalk before frost comes and should then be stored where it will have sufficient ventilation, so it will not heat in curing. The kernels should be practically free from soft white matter in the endosperm and should have a moisture content of about 12 per cent. If properly stored, pop corn will retain its popping quality for a number of years.

INCREASE IN VOLUME DUE TO POPPING.

Good grades of pop corn will increase in volume from twelve to twenty times on popping. In popping there is usually more or less waste, due to imperfections in the kernels, slow or uneven application of heat, or other causes. Factories have reported from 7 to 25 per cent of waste in commercial grades of pop corn.

CULTURE OF POP CORN.**SOIL.**

Any soil that is adapted to field corn will produce pop corn. For best results the soil should be fertile and well drained. The crop prefers a soil of the sandy-loam type. Avoid low muck or peat soils, as they tend to retard maturity in the fall. Where grown for commercial purposes pop corn usually takes the place of the ordinary field corn in a rotation. Pop corn, oats, and clover make a good rotation, planting the pop corn on the clover sod. The clover may be sown with the oats. The land may be plowed in the fall or early spring. Old sod land, however, should be plowed in the fall, to expose the worms and other insects to the freezing temperature of winter.



FIG. 1.—A field of drilled pop corn, planted too thick for best results. Note the curling of the blades due to the thick stand and dry weather.

PLANTING AND CULTIVATING.

Pop corn should be planted early, so it will have a long season in which to grow and mature. It is advisable to plant as soon as the ground is warm enough for good germination of the seed. The seed bed should be thoroughly harrowed and pulverized. The rows may be laid off about $3\frac{1}{2}$ feet apart and the kernels dropped so the plants will stand from 8 to 10 inches apart in the row. If it is desired to cultivate the pop corn both ways, a stand of three or four plants per hill with the hills 3 feet 4 inches apart each way will be thick enough. Pop corn has a strong tendency to sucker when planted thinly, especially on rich ground (figs. 1 and 2).

From 2 to 4 quarts will plant an acre, depending on the size of the kernels and the thickness of planting. A quart of White Rice



FIG. 2.—A field of pop corn planted in hills. Pop corn has a stronger inherent tendency to sucker than field corn; on rich ground it often suckers profusely.



FIG. 3.—A 2-row cultivator used on listed pop corn. The middle row is cultivated on the return trip.

pop corn contains about 7,000 kernels. There will be 3,920 hills per acre if the hills are 3 feet 4 inches apart each way. If planted at

the rate of 4 kernels per hill, it will take 15,680 kernels, or a little over 2 quarts, to plant an acre of 3,920 hills. If the kernels are sown 8 inches apart in rows $3\frac{1}{2}$ feet apart, it will take about the same quantity to plant an acre. The usual quantity of White Rice pop corn planted per acre is about 5 pounds.



FIG. 4.—A shovel cultivator.

An ordinary corn planter may be equipped with the special plates necessary for planting pop corn. For planting the common rice pop corn the holes in the plates should be three-eighths of an inch in diameter, countersunk on one side.

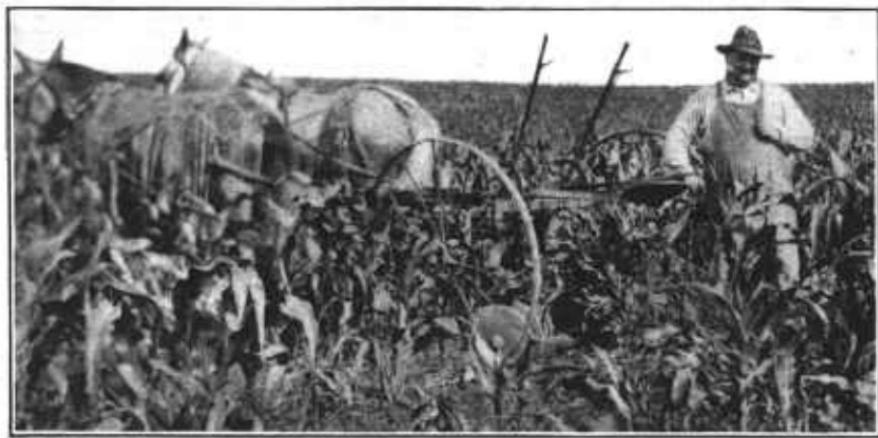


FIG. 5.—A disk cultivator used for cultivating pop-corn fields.

Begin cultivation as soon as the plants are a few inches high. Repeat the cultivation every week or 10 days, and oftener if heavy rains cause the surface to become crusted. Prepare a deep seed bed before planting and cultivate shallow after planting. For types of cultivators see figures 3, 4, and 5.

RIPENING.

Pop corn ripens in 100 to 130 days from planting. The ripening may be hastened by liberal applications of a phosphatic fertilizer, but is sometimes retarded by the use of too much stable manure. It should ripen before frost comes; otherwise its popping quality will be injured and it will then have little value for marketing.



FIG. 6.—Picking pop corn by hand from the standing stalks.



FIG. 7.—Gathering pop corn with a modern corn-harvesting machine.

HARVESTING AND STORING.

The crop can be harvested as soon as it has fully matured and the husks have whitened, provided the ears are not bulked, but are so placed that they will dry quickly. The best quality of pop corn is obtained by allowing the ears to ripen fully and dry out as much as possible on the standing stalks. Cutting the stalks with a corn binder and standing the bundles up in shocks in the field to allow the

pop corn to cure is not recommended. The most satisfactory way of harvesting is by hand from the standing stalks (fig. 6). Some farmers use a modern corn harvester (fig. 7), and in some sections pop corn is husked from the shock (fig. 8).

The husked corn should be stored in well-ventilated cribs where it can cure without heating (figs. 9, 10, and 11). If the crib is wide, a



FIG. 8.—Husking pop corn from the shock in order to save the stover.

special A-shaped ventilating device should extend through the middle of the crib lengthwise, and provision should also be made for ventilating crosswise (fig. 12). If pop corn is not supplied with a free



FIG. 9.—Elevator and pop-corn cribs at Arthur, Iowa. Each crib has a capacity of 18,000 bushels of ear corn. circulation of air while curing it is likely to heat, and this heating will injure the popping quality and also the food value.

MARKETING.

Pop corn will not be ready for marketing until the summer following the season in which it is grown. Manufacturers say it should not be put on the market before June 1. Growers often sell their crop by the pound on the ear to elevator men, who store it in cribs and shell it as needed for the market. In some cases farmers sign con-

tracts at the time of planting in which they agree to deliver the yield of entire fields at harvest time at so much per pound of ears. Some growers have well-constructed cribs of their own in which they store the crop and sell direct to the consumer. This enables the growers to hold their crop until it can be marketed advantageously. Pop



FIG. 10.—Elevator men taking in the crop at time of harvesting, Odebolt, Iowa.

corn is usually shelled and put up in 100 or 150 pound bags for the trade. Many prefer a cylinder sheller for shelling pop corn.

Where grown for local markets, as in the Eastern States, it is usually sold at from $1\frac{1}{2}$ to 3 cents per pound of ears, and storekeepers retail it at from 5 to 10 cents per pound of ears or in pound boxes, shelled, at 10 cents a pound.

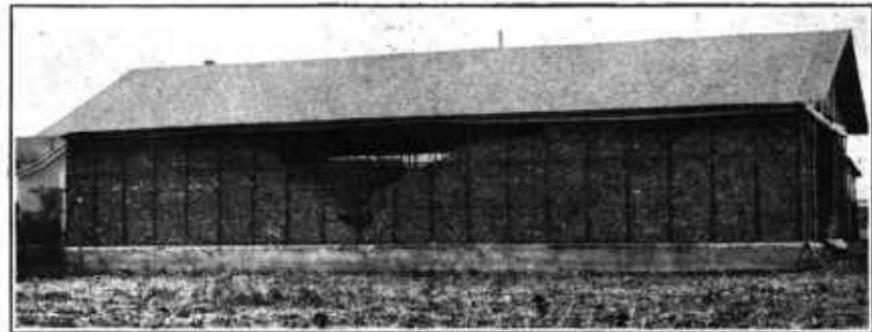


FIG. 11.—A rat and mouse proof crib having a concrete foundation, an iron frame covered with wire netting, and storm curtains on sides and ends.

The market prices of pop corn vary considerably from year to year. In 1908 the market price was as low as three-fourths of a cent per pound, and in 1912 as high as 6 cents per pound.

In most States the weight per bushel is the same for pop corn as for field corn, 56 pounds shelled or 70 pounds of ears, air-dried, constituting a bushel. One hundred pounds of ears should give 80 pounds of shelled pop corn.

SEED PLAT.¹

It is advisable to have a seed plat planted with exceptionally good seed and in an isolated location to furnish seed for the next year. In this plat all weak, barren, or otherwise inferior stalks should be detasseled just as soon as the tassels appear and before they have shed any pollen. At harvest time the rows should be gone over and the seed ears selected from the best stalks. Early maturity is desirable in most localities and can be attained by taking seed each



FIG. 12.—Interior of a pop-corn crib. Note the ventilating devices running lengthwise and crosswise. The sections of the ventilators are removed as the crib is emptied.

year from good early-maturing stalks. It is not necessary to procure new seed from a distance each year for planting; neither is it advisable to do so. Pop corn will not be at its best until fully acclimated, which takes several years, and for this reason home-grown seed is to be preferred. The yearly planting of a seed plat with seed from the best stalks of the previous crop will improve the strain at the same time it is becoming adapted to the soil and climatic conditions of the locality.

¹ For a fuller discussion of the seed plat, see Farmers' Bulletin 229, entitled "The Production of Good Seed Corn," and for information regarding the care of seed corn, see Farmers' Bulletin 415, entitled "Seed Corn."

MARKET SUPPLY OF POP CORN.**PRODUCTION.**

The main portion of the crop which finds its way to the large markets is grown in a few localities in Iowa and Nebraska by farmers who make a specialty of producing and handling pop corn. Usually from 10 to 50 acres are grown on single farms, the pop corn taking the place of field corn in the rotation.

During the past much of the crop was grown on contract, but at present farmers are becoming more independent. Many have cribs of their own in which they store and cure their crop and take chances on the market price rising higher than the contract price or the price at harvest time. In Iowa and Nebraska elevator men have been accustomed to buying up the bulk of the crop at harvest time and selling it to manufacturers, commission merchants, and jobbers.

USE.

The market supply is taken by manufacturing establishments that turn out crackajack (crackerjack) and other forms of pop corn confectionery, by pop corn venders, and by dealers who supply local trade. Venders usually handle roasted peanuts in connection with pop corn. Shelled pop corn in 1-pound pasteboard packages sells extensively in New England for home popping.

POP-CORN PRODUCTS.

A large quantity of pop corn is used annually in the manufacture of pop-corn package goods. In these the popped corn is coated with a preparation of sugar, glucose, and molasses, and in some cases with chocolate. Some packages contain small quantities of peanuts, and in others both peanuts and sliced coconut are mixed with the pop corn. These confections are put on the market under special trade names and usually sell for 5 cents per package. Other pop-corn preparations are corn bar, sugar-coated pop corn, pop-corn balls, and pop corn bricks. The pop corn package goods familiarly known as crackajack (crackerjack), etc., have become quite popular and are sold in large quantities at parks, summer resorts, picnics, fruit stands, stores, railroad stations, and on trains.

EXPORT TRADE.

The export trade in pop corn is as yet in its infancy. Small shipments of pop corn were made from several of our ports during the past year and some popping machines were exported. This phase of the industry needs to be encouraged.

DOES IT PAY TO GROW POP CORN?

The question "Does it pay to grow pop corn?" is frequently asked, and the answer to it is "Yes." It pays to grow pop corn, but owing to the limited market for this crop it would not be advisable to begin its culture on a large scale. The supply at present just about equals the demand. No farmer should expect to become rich in a few years' time by growing pop corn. If the good years are averaged up with the poor ones this crop will be found to pay about as well as field corn. Any farmer in the corn-producing States can produce pop corn, but the profit depends largely upon the producer's ability to grow pop corn of good quality, store his crop properly, and market it advantageously.

